



Prompt Gamma Neutron Activation Analysis (PGNAA)



Developer: Northrop Grumman STC
Contract Number: DE-AC21-93MC30177
Crosscutting Area: CMST

**Deactivation &
Decommissioning**
FOCUS AREA

Problem:

Characterization of radioactive contamination of concrete is required to plan, direct, and guide Department of Energy (DOE) deactivation and decommissioning of many weapons-complex facilities. The most common method of determining contamination levels in concrete and soils is the collection and analysis of core samples. This method is time consuming, expensive, potentially hazardous to workers, and may result in errors in estimating the severity of contamination because of the use of discrete sampling.

A method of characterizing elemental contamination in concrete or soil is needed. Ideally, this method would reduce risk and cost by being in situ, non-invasive, rapid, less expensive than conventional chemical analysis, and capable of providing depth profiles.

Solution:

Develop a rapid (near real-time) in situ field survey system based on Prompt Gamma Neutron Activation Analysis (PGNAA) to characterize contaminants in concrete and soil. The N-SCAN™ system has been developed to meet DOE's needs.



Benefits:

- ▶Rapid, subsurface characterization of concrete for radioactive and hazardous contaminants
- ▶Non-invasive, in situ analysis for remediation planning and performance monitoring
- ▶Reduced costs, worker exposure and records administration compared to sample collection, packaging, transport, and laboratory analysis

Technology:

The N-SCAN™ technology design was intended to provide rapid (near real-time), subsurface characterization applicable to soil and concrete, remediation system performance monitoring, and on-site core and sample evaluation. The system combines a specially modified electronic neutron generator tube, high-efficiency gamma detection, and computer-directed microsecond control capability of the source/detection processes. The goal is to advance the state of the art in PGNAA, thereby providing unprecedented



sensitivity in trace element detection.

Incident neutrons initiate nuclear reactions in atoms of the sample matrix and contaminants. These nuclei emit energetic "prompt" gamma rays in 10-14 seconds, which are signatures of the original target atom - matrix or contaminant. When a PGNA scan is complete, no detectable radioactivity is present, and no waste will be generated.

The area survey system, patterned after a field survey prototype already developed and demonstrated for detection of trace uranium in soil, will be calibrated for the simultaneous characterization of a suite of target contaminants in concrete. A carefully correlated, computer-controlled sequence of neutron emission and gamma detection is employed to produce data with high signal-to-background ratios, even for trace contaminants in massive matrices (e.g., concrete or soil). N-SCAN™ couples this measurement capability with algorithms produced from benchmarked radiation transport modelling to attempt near real time, in situ trace level contamination characterization, including depth profiles.

Project Conclusion:

This project was terminated in April 1995 at the end of Phase I. The consensus from external stakeholders at Oak Ridge and Fernald was that this particular technology could neither provide the necessary detection limits for the target contaminants nor provide a greater, more suitable selection of

contaminants. The demonstration to be held in Phase I by Westinghouse in coordination with FERMCO was canceled because of the limited suite of contaminants that could be detected with this technology.

Although some useful information was obtained, this technology could not (even with Westinghouse's best technical estimate) provide satisfactory detection limits, necessary for site remediation, for the required contaminants. Therefore, the program was terminated.

Contacts:

The Westinghouse Science and Technology Center develops innovative technologies for environmental remediation. For information on this project, the contractor contact is:

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DOE's Federal Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

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